



Missouri
Department of
Natural Resources

Biological Assessment Workgroup
Agenda Topics and Discussion Summary

February 26, 2014

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Bioassessment Workgroup Meeting

February 26, 2014

Agenda Topics and Discussion Summary

Biological Assessments and Habitat Comments

- **Overview of how the recommendations and unresolved issues were incorporated into the 2016 Listing Methodology Document (LMD)** (Refer to Table 1 for additional information).

- John Ford provided an overview of the Bioassessment Workgroup Recommendation document and how those recommendations were incorporated into the 2016 LMD.

Item 1. Continue using DNR method for selecting small control streams: These procedures were developed by the DNR lab. These are currently not in the LMD. It was agreed that information would be included as an appendix to the 2016 LMD. (Completed: See Appendix E of Revises 2016 LMD)

Item 2. Continue DNR policy of not using biological samples collected during extreme climatic conditions: Currently the assessments do not include biological data collected during extreme non-representative conditions (e.g., drought or flood). This language will be added to the LMD. (Completed: See Appendix E of Revised 2016 LMD)

Item 2. a. Describe procedure for assessing small biological data: The LMD currently has a footnote saying “both reference streams and small control stream data will be used.” There was much discussion relating to this topic. The Department explained it may not be appropriate to score small headwater streams to the regular biological reference streams provided in water quality standards. Therefore, to gain an idea of how these small streams compare, the field biologists are collecting data on both small candidate reference streams and biological reference streams (wadeable perennial streams). The Department is not using the candidate reference streams to calculate criteria, only comparing information to determine if the scores compare to the biological reference streams. Specific discussion and clarification was provided for Buffalo Creek and Hays Creek. If the small candidate reference streams don’t compare well with the biological reference streams, then the test stream is compared to the small candidate reference stream. There may be times where a weight of evidence or best professional judgment approach is followed when the candidate reference stream data is split (e.g., 50/50). If the data is questionable, lack of confidence in the data, or it is split and hard to interpret, then the data would be considered inconclusive and the stream is scheduled for follow-up monitoring. Much of the information is provided in the biological reports and are available the Environmental Services Program website. Overall, it was recommended additional information could be included in the 2016 LMD to provide a framework on how macroinvertebrates are assessed using candidate reference streams. Also a link from the 303(d) website will be provided. (Completed: See Appendix E of Revised 2016 LMD and 303(d) webpage for links to Biological Assessment Reports for Aquatic Macroinvertebrates).

Item 2. b. Describe how macroinvertebrate habitat data will be used in the assessment process. The LMD currently states macroinvertebrates data with habitat scores less than 75% of reference streams will not be used.

Bioassessment Workgroup Meeting

February 26, 2014

Agenda Topics and Discussion Summary

Item 3. Fish IBI scores on first and second order streams will not be used to judge impairment. This is clearly stated in the 2016 LMD. Only first and second order streams will be assessed.

Item 4. Fish IBI scores will be assessed in the same statistical manner as Macroinvertebrate Stream Condition Index (MSCI) invertebrate scores. This is clearly stated in the LMD tables showing statistical methods and proposed in the 2016 LMD. Fish index of biological integrity (IBI) data will be evaluated similar to invertebrate assessment processes. The fish data will be compared to the 36 score and to determine the percentage of scores above or below this threshold.

Item 4. a. Interpretation of Fish IBI scores should include consideration of habitat and other potential impacts on these scores other than water quality. The 2016 LMD currently has two footnotes indicating the Department will consult with Missouri Department of Conservation (MDC) on other reasons for low IBI scores. An example on Buffalo and Hays creeks was provided. MDC was consulted not only on this stream but a list of streams where the Fish IBI scores were low. In these discussions the Department and MDC removed streams where habitat was considered a problem and those streams considered losing, or had low water quantity (volume). **It was agreed that habitat scores will be included on the biological assessment sheets for fish and invertebrates. The reference stream habitat scores will also be included.** (Will incorporate into future biological assessment worksheets)

Item 4. b. The Quality Assurance Project Plan (QAPP) documents supporting the Resource Assessment and Monitoring (RAM) program are sufficient. The LMD currently has a general footnote discussion of quality assurance which covers all types of data used in the assessment. In the past Matt Combes, MDC, provided a document to the workgroup. At that time, the workgroup was satisfied with the information provided.

Item 5. -6. How other biological data should be used. The LMD currently allows a judgment of impairment based only on this type of data. Further discussion is provided later on the agenda. Any new stream size designation will not be incorporated into the LMD until Water Quality Standards are approved.

Discussions continued regarding headwater stream size classification: Matt Combes described the fisheries work being completed by the University of Missouri (MU) Fish Co-op unit regarding headwater reference reaches. He stated a graduate student is in year 1 of a 3-year project. The overall goal is to have a group of headwater reference streams within 3 years. MDC will start field work this summer.

The stream size ranges are published by Pflieger. The Department and MDC are exploring several of the attributes from the Valley Segment Type (VST). Currently, they are looking at five attributes relating to size range to find the best available streams for reference. Overall, there are hundreds of attributes to consider.

Bioassessment Workgroup Meeting

February 26, 2014

Agenda Topics and Discussion Summary

Matching stream order and VST. Is this possible to match up? The criteria are different between Ozark and prairie streams. Overall, the first digit corresponds to the stream size, not stream order. The LMD will be updated to incorporate VST stream size when the Water Quality Standards are approved. If this should happen prior to the 2016 303(d) list, then information will be sent out to the workgroup or explained during the public notice.

- **Fish habitat metrics (the 0.39 threshold):** The habitat score was created to allow the Department to determine if the Fish IBI score was a result of a habitat impairment. Matt Combes provided an overview of how the provisional information was developed. It will be used until the MU Fish Co-op workgroup has completed their work. MDC looked at the 70 published reference sites cited in the Doisey and Rabeni publication. For all of those sites, the Fish IBI scored 36 or above (not impaired for fish). The lowest habitat score obtained from these sites was .39. The Department sent MDC a list of waters potentially impaired for fish bioassessments. MDC looked at this list and compared those waters against the losing streams GIS layer, and field observations provided by the field crews noting if a significant stream volume was being lost to the streambed. The MU Fish Co-op workgroup is currently developing a threshold similar to this, but fitted to Missouri data. The QCPH1 habitat metrics value was developed by the Environmental Protection Agency (EPA), Office of Research and Development staff from EPA Regional Environmental Monitoring and Assessment Program (REMAP) data. The data includes reference reach and core sites from all four states within EPA Region 7. The REMAP data is not a perfect fit for Missouri. A statewide habitat index will be developed through the MU Fish Co-op workgroup and specific to Missouri.

There is not one habitat protocol that can be used for both fish and invertebrates. For the visual aspect of the assessment, it is important the same scientist complete this work to provide consistency and standardization by the field staff conducting the work.

Discussion on how a site with missing habitat information is handled during the assessment process. It was recommended that any missing habitat information be noted on the biological assessment worksheets and a web link and/or reference to the bioassessment report title be added to the assessment worksheets. (Will be incorporated into future biological assessment worksheets)

- **Aquatic macroinvertebrate habitat scores and how those compare to the 75% reference conditions and MCSI scores:** The entire stream segment is not looked at to determine if it is meeting the 75% of reference conditions. The Department may look at stream segments to make determinations of which segments are meeting 75% of reference. Therefore, if only a portion of the stream meets 75% of reference conditions, then this portion may be evaluated against the (MCSI) score. Streams do not have to be as good as reference (90% of reference conditions) to support the use; they just need to support the aquatic life beneficial use (75% of reference conditions). The purpose of the 305(b) report is to show if the stream is supporting or not supporting the beneficial use.

Bioassessment Workgroup Meeting

February 26, 2014

Agenda Topics and Discussion Summary

- **The methods followed for choosing appropriate reference and control streams for biological data comparisons:** reference item 2.a. above.
- **Biological assessment worksheets – additional information requested to be added:** This information was previously discussed in Item 4.a. above.
- **Interpretation of “other biological data”:** In the past, biological data (other than Fish IBI or aquatic macroinvertebrates) could be used as stand-alone data to make an assessment decision. What was recommended by the bioassessment workgroup and what will be updated in the 2016 LMD, is this data will be used, but will not be the sole source for an impairment decision. It will be used as part of the “weight of evidence” approach in conjunction with any other biological data or narrative data. (Completed: See Appendix E of Revised 2016 LMD)
- **“Weight of evidence” approach:** Several 303(d) listing cycles ago, at a Clean Water Commission meeting, there were a number of discussions regarding how the Department assessed narrative criteria (criteria without numeric limits). For fish tissue and sediment quality, the Department established translator values that are used in lieu of a numeric value. The Commission asked the Department to use a weight of evidence approach when assessing this data. Therefore, all the various types of data (e.g., fish tissue, biological, sediment, water quality, etc.) available for a stream are used together to make a determination if that stream is impaired or unimpaired. It would be very difficult to provide a detailed description of how the weight of evidence approach would be followed, due to the number of variables and situations that need to be considered. It was asked from the workgroup to provide additional wording to how the weight of evidence would be used to give biological data more weight. In general, the Department will collect other information (e.g., biological) in conjunction with numeric translator data to provide evidence to support a decision. (Additional wording was added to page 15 of the Revised 2016 LMD and Appendix E)

General Assessment Methodology Comments

- **One in three-year listing criteria for toxicity:** This is an EPA guideline that the Department agrees with. There is a lot of evidence that shows if you have one single toxic event that kills most of the biological life in a stream, it can take up to nine months to a year for the aquatic faunal community to recover. Therefore, if you have more than one toxic event occurring, then you may have a diminished faunal community more than half the time during a three-year period. This applies to both acute and chronic toxicity.
- **Methods used to list and delist waters:** The reason for using a more rigorous level of significance (e.g., 0.1 to 0.4) for certain parameters (e.g., bottom deposits and toxic chemicals relating to human health) is because this increases the probability a water is

Bioassessment Workgroup Meeting

February 26, 2014

Agenda Topics and Discussion Summary

actually meeting water quality standards. This process prevents a water from bouncing back and forth from being listed and delisted if assessed using the same methods for listing.

There was discussion regarding a higher burden of proof needed to delist a stream. In summary, if a water is listed as impaired and significant management practices have been completed in the watershed, the stream would be assessed using only the newer data collected after the date the majority of the practices were implemented. If no management practices have been implemented or other documented changes have occurred in the watershed, monitoring would continue until enough data has been collected to indicate the water is meeting beneficial uses. For waters where long-term trend data is available, it was suggested the Department look at the dataset temporally and spatially to determine if the data can be broken up and either assessed independently of one another or focus on the newer data. (Will continue to review data for temporally or spatial differences)

The Department can work through a few scenarios to determine how much difference there is by changing the level of significance from 0.1 to 0.4 (Completed. Attached as Attachment I of this summary)

- **Binomial probability for used for assessing greater than 30 samples:** Previously the Department had been using the binomial probability for sample sizes up to 30, any higher sample sizes the binomial probability distribution coefficient values became too large to handle. However, the Department has found that MicroSoft Excel has a binomial distribution feature that allows the calculation of samples sizes greater than 30. The binomial probability distribution will be used for the 10% rule outlined for all of the conventional pollutants (pH, temperature, dissolved oxygen, total dissolved gases). This provides more confidence in the decision with a Type 1 – alpha error rate of 10%, and provides a 90% confidence rate that the listing is correct. This is an improvement in the LMD and keeps streams off the impaired list that should not be there.
- **Method followed for calculating duplicate samples:** Duplicate samples noted on the sediment assessment worksheets were not handled consistently over time. These sediment worksheets were reviewed and now all duplicate samples are averaged using the arithmetic mean and recorded on the assessment worksheet as one sample. In addition, as a follow-up to a Clean Water Commission meeting comment, the sediment PECs were calculated using the geometric mean instead of arithmetic mean. This resulted in four delistings.
- **Method followed for handling censored data:** Method for values less than the detection limit: Remove the less than value, divide the value by 2. If that value is greater than the criterion value, this data is dropped out and not used during the assessment. If that value is less than the criterion value, that value is included and used in the assessment. There was some discussion if the sample is dropped out, should it still be counted in the sample size, where it plays a role in calculating a percent exceedance. The participants were asked to provide written comments on how the Department should to handle this in our assessment procedure.

Bioassessment Workgroup Meeting

February 26, 2014

Agenda Topics and Discussion Summary

Data Age, Quantity, Quality, and Minimum Sample Size

- **Age greater than 7 years old:** The Department's current position is any data that is still representative of current conditions can be used in the 303(d) listing assessment. What would exclude older data is the evidence (through documentation) that changes have been made in that watershed that would potentially change water quality enough where the prior data collected in the watershed is considered no longer representative of current conditions. In the case where a site has several years of data (30+ years), the Department will only look at the most recent data (e.g., within the last 5 or 7 years). The Department may look back further than 7 years at sites with smaller datasets and there has not been any documented change in the watershed. **When data older than 7 years is used in an assessment it should be noted on the assessment worksheet that no known changes in the watershed has occurred.** (Will continue to indicate how/why older is used in assessment)
- **Minimum sample size:** EPA has stated numerous times in their guidance documents that there should be no minimum sample size stated in the LMD. The definition of the data codes provides information about the amounts of data needed to make an assessment. For a few sample types minimum sample sizes are provided in the LMD [e.g., biological (2), *E. coli* (5) (within the recreational season), and sediment quality (3)]. Some types of data are collected during certain times of year to characterize low flow, worst case scenarios (e.g., dissolved oxygen). This dataset may be small, but representative of typical conditions that can persist for several months during that timeframe. Additional information can be obtained by reviewing the assessment worksheets. They provide an indication on how much data was used to make an assessment decision.
- **Data transparency - posting all data to web to support 303(d) listing:** Currently the Department's QAPPs are not available on-line, but can be provided upon request. When data is obtained from other entities, the Department will ask for additional information to ensure the data is of quality. Examples include field/lab staff training and experience in completing this type of work, written protocols, analytical method numbers (if EPA approved), and etc. This information is evaluated and this organization's data is coded in the Department's database as acceptable or unacceptable for assessment purposes.

When data is pulled from the Environmental Services Program's Laboratory Information Systems (LIMS) database, the quality control data (field and trip blanks) are also downloaded into the Water Quality Assessment (WQA) database. The WQA database is available from the Department's website. All the data downloaded into the WQA database can be viewed along with data qualifiers or flags. **A web link to the WQA database will be provided on the 303(d) website** (Completed: see 303(d) webpage). For quality control data received from external entities, this information may need to be requested from that entity. Sample spike information would need to be obtained from the laboratory.

Bioassessment Workgroup Meeting

February 26, 2014

Agenda Topics and Discussion Summary

Sediment Toxicity

- **Method for assessing a water body segment vs reach:** When the dataset is viewed and assessed, the Department will look for marked differences between segments. If there are differences, the water body will be separated into segments based on the spatial differences in the data, and these segments assessed separately. It is noted on the 303(d) list which part of the stream or segment is impaired. When this information is provided to EPA, they will list the entire stream reach as impaired. The Department will always maintain the actual impaired segment in our assessment database, and it will be noted in the TMDL document. **It was recommended to add general wording or clarification on how spatial averaging is conducted and what would cause segmentation of the data/reach.** (Completed: See page 15 of Revised LMD)

TMDL

- **TMDL priorities:** In the past, 303(d) lists were required to include the prioritization of TMDLs. In recent years EPA has stated prioritization of TMDLs does not have to be included on the 303(d) list. To satisfy this requirement, EPA now only asks for a TMDL schedule to be submitted along with the 303(d) list. The TMDL program provided an update on their priorities. Many are already low priorities (e.g., nutrients, ammonia, chloride, sediments, dissolved oxygen, etc.). The only exception is the development of bacteria TMDLs. EPA has an expectation that states will complete a certain number of TMDLs annually. Therefore, the Department cannot keep deferring the development of TMDLs for future years since they are required to be completed within a 13-year timeframe. (Completed: Web link to TMDL schedule added to page 25 of Revised 2016 LDM)

WQ Criteria

- **Groundwater criteria (*E. coli* assessments):** The Department does not have a beneficial use criterion for groundwater. Therefore, the Department has agreed to remove this from the LMD. The LMD has been updated and is consistent with water quality standards for the protection for losing streams. The losing stream criterion is not to be an exceeded value. It will be assessed the same as dissolved oxygen, pH, and water temperature, which are also “not to exceed” standards. This data will be assessed using the 10% rule and binomial probability distribution.
- **Beneficial use assessments limited to criteria listed in MO Water Quality standards:** EPA requires all states to consider all water quality standards (numeric, narrative, and antidegradation provision) when assessing waters.

Other Discussions:

Information regarding the category 2b, 3b, 4a waters is provided in the appendices of the 305(b) report. GIS shape files for category 4 and 5 waters should be available from the MSDIS website.

Bioassessment Workgroup Meeting

February 26, 2014

Agenda Topics and Discussion Summary

For sediment assessment, the sediment calculations were updated from using the arithmetic mean to geometric mean based upon the information presented in the MacDonald (2000) paper. Therefore, the Department is looking at revising the assessment procedure for assessing sediment metals from 150% of the PEC and PEQ to 100%, with the exception of arsenic which will remain at 150%. This will allow the Department to still meet they type 1 error rate, however, type 1 error rates for organic constituents will still need to be reviewed. (Completed: Attachment 2 of this summary)

There were a couple articles produced by MacDonald: 1) Joplin mining area and 2) old lead belt mining area. Those papers were reviewed by John Ford, DNR, who also contacted MacDonald and sent information to Chris Ingersoll, for review/comments. The purpose of the LMD is to develop guidelines that allows a clear process for distinguishing impaired streams from unimpaired streams. Information was not used from that provided in the later papers (Joplin mining area) because the later papers did not use PEC values, they used TTS10 levels. The TTS10 levels allowed a certain amount of toxicity in the aquatic community, therefore, allowing a certain amount of impairment to occur within the aquatic community. This process was not consistent with the 303(d) listing process to separate impaired waters from unimpaired waters. In addition, both papers discussed toxicity testing using the same type of organisms (particular species of *Hydrella* and mussels), but the results presented were opposite of one another. In addition, in one of those studies they used mussels that were of an older life stage, therefore, their sediment toxicity exposure was much shorter. The Department believes MacDonald's (2000) paper provides the best assessment option. It was requested that the Department's comparison summary be provided to the workgroup. (Completed: Attachment 3 of this summary)

Meeting Action Items:

- A new appendix will be added the LMD to discuss the assessment process of biological data and the weight of evidence approach. (See Appendix E of Revised 2016 LMD)
- John Ford to work through scenarios to determine how the different test alphas (0.1 and 0.4) affect various types of datasets. (See Attachment 1)
- Trent and/or workgroup members will provide suggested wording regarding the weight of evidence approach.
- The workgroup was asked to provide suggested wording regarding how to handle censored data that is dropped out (not used) during assessment purposes. Should it still be counted in the sample size?
- Provide the comparison document completed by John Ford regarding the MacDonald publications for the Joplin area and old lead belt area. (See Attachment 3)

Table 1. How Bioassessment Work Group Recommendations Were Incorporated into 2016 LMD.

Work Group Recommendation	What is in LMD?	Change Needed in LMD?
1. Continue using DNR method for selecting small control streams.	These are procedures developed by DNR lab. Not currently in LMD.	Should this be added to LMD? It would add about 2-3 pages to the document.
2. Continue DNR policy of not using biological samples collected during extreme climatic conditions.	This language is already in the LMD.	
2a. Describe procedure for assessing small stream biological data.	LMD currently has footnote saying “both reference streams and small control stream data will be used”.	Should this be expanded to include the exact wording in the WG recommendation? This would add about ½ page to the LMD.
2b. Describe how invertebrate habitat data will be used in the assessment process.	LMD currently says invert. data with habitat scores less than 75% of reference stream mean will not be used.	Should this be expanded to include exact wording in WG recommendation? This would add about 1/3 page to the LMD.
3. Fish IBI scores on first and second order streams will not be used to judge impairment.	This is clearly stated in the current LMD.	
4. Fish IBI scores will be assessed in the same statistical manner as MSCI Invertebrate scores.	This is clearly stated in the LMD tables showing statistical methods.	
4a. Interpretation of Fish IBI scores should include consideration of habitat and other potential impacts on these scores other than water quality.		Should DNR develop more specific language describing the consultation process? habitat metrics used? their derivation? And describe other factors such as methods of assessing low water volume? This might add 2-4 pages to the LMD.
4b. The QAPP documents supporting the RAM program are sufficient.	LMD currently has a general discussion of quality assurance which covers all types of data used in the assessment.	
5-6. How should other biological data be used.	LMD currently allows a judgment of impairment based only on this type of data.	This is a discussion topic in today’s meeting.

Attachment 1- Type One Error Rates For Different Test Alphas

Table 1 below uses the binomial probability distribution to calculate Type One error rates for invertebrate community data assuming that reference streams in the EDU in question have an MSCI score of 16 or higher in 80 percent of all samples. A Type One error would be a decision that the stream has an impaired invertebrate community when in fact, it does not.

Table 1. Type One Error Rates for Assessment Decisions on Stream in an EDU with 80 percent sustaining scores on reference streams.

No. of Samples with MSCI scores less than 16	Total Number of Samples						
	10	12	15	18	22	27	34
2	.624	.725					
3	.322	.442	.602	.729			
4	.121	.205	.352	.499	.668		
5	.033	.073	.164	.283	.457	.652	
6			.061	.133	.267	.461	.700
7				.051	.133	.287	.534
8					.056	.156	.367
9						.074	.227
10							.125
11							.062

Table 2. Number of Invertebrate Samples with MSCI Scores of 16 or Greater needed to make a decision that a stream has an unimpaired invertebrate community.

Test Alpha	Total Number of Samples						
	10	12	15	18	22	27	34
0.1	6	8	10	12	15	19	24
0.2	7	9	11	13	16	20	25
0.3	8	9	12	14	17	21	26
0.4	8	9	12	14	17	21	27

For sample sizes of 8-13, using a test alpha of 0.4 instead of 0.1 would require one-two more samples with a score of 16 or higher. For sample sizes 14-30 it would require two more samples to have scores of 16 or higher. For samples of 31 up to presumably 50 or 60, it would require three more MSCI scores of 16 or higher.

Table 3. Number of additional samples needed to show unimpaired after impairment decision is made using the 75% Rule, on a stream in an EDU with 80 percent sustaining scores on reference streams.

# of Samples Below 16 / Total # of Samples -- 75% Rule						
75% Rule	2/2	3/3	3/4	4/5	5/6	6/7
# of additional samples with scores ≥ 16 needed to delist a water. *						
75%	6	9	8	11	14	17
Total # of Samples	8	12	12	16	20	24
0.1	6	5	5	5	9	12
Total # of Samples	8	8	9	10	15	19
0.2	6	5	5	7	11	16
Total # of Samples	8	8	9	12	17	23
0.3	6	7	7	9	14	18
Total # of Samples	8	10	11	14	20	25
0.4	6	9	9	11	16	21
Total # of Samples	8	12	13	16	22	28

* When the total number of samples reaches 8 or more, binomial probability is used instead of the 75% rule. Numbers shown for the 75% row are for comparison if we listed using the 75% rule what number it would take to delist using the 75% rule. (Purely for comparison, I'm not suggesting a change here.)

Table 4. Number of additional samples needed to show unimpaired after impairment decision is made using binomial probability, on a stream in an EDU with 80 percent sustaining scores on reference streams

# of Samples Below 16 / Total # of Samples -- Binomial Probability							
Test Alpha	4/(8-9)	5/(10-13)	6/(14-16)	7/(17-20)	8/(21-24)	9/(25-28)	10/(29-32)
# of additional samples with scores ≥ 16 needed to delist a water.							
0.1	2	4	3	4	4	4	4
Total # of Samples	10	14	17	21	25	29	33
0.2	4	6	7	8	8	8	9
Total # of Samples	12	16	21	25	29	33	38
0.3	6	9	9	11	11	12	13
Total # of Samples	14	19	23	28	32	37	42
0.4	8	11	12	14	14	15	16
Total # of Samples	16	21	26	31	35	40	45

Attachment 2 - PEQ Comparisons at 150% and 100%

Results of using 100% PEL vs 150% PEL				
WBID	WB Name	HUC 8	Change from current listing status	Already Impaired for Metals in Sediment
1943	Courtois Cr.	7140102	Y - Ni	Y
3961	Crooked Cr.	7140102	Y - Cu	Y
1946	Indian Cr.	7140102	Y - Ni, Cd	Y
2080	Big R.	7140104	Y - Zn	Y
2168	Flat River Cr.	7140104	Y - Cd	Y
2111	Old Mines Cr.	7140104	Y - Pb,Zn BUT INVERT COMM NOT IMPAIRED	N
2128	Pond Cr.	7140104	Y - Pb	Y
2120	Shibboleth Br.	7140104	Y - Hg	Y
2916	Big Cr.	8020202	Y - Zn	Y
2863	Village Cr.	8020202	Y - Pb	Y
3965	Strother Cr.	11010007	Y - Cd	Y
2755	W. Fk. Black R.	11010007	Y - Zn	Y
3810	Douger Br.	11070207	Y - Cd	Y
3217	Turkey Cr.	11070207	Y - Pb	Y

Attachment 3 – Sediment Toxicity Correspondence Regarding the Tri-State and Southeast Mining Areas

Date: 1-20-2012

To: Frances Klahr, Mike McKee, Chris Ingersoll, Bob Hinkson

From: John Ford, DNR Water Protection Program

Below are my notes (to myself) on Besser's 2009 report. We are in the process of revising our impaired waters methodology. We do not have sediment criteria promulgated within our water quality standards, but we recognize the need to identify waters that appear to have toxic levels of contaminants in sediments. Thus, we have been using 150% of the consensus-based PEC values in MacDonald, Ingersoll and Berger 2000 in our current methodology. We've recently reviewed the MacDonald report on sediment toxicity in the Tristate district and Besser's report on the Old Lead Belt and are looking for comments on whether or not the findings in these two reports should cause us to change our current use of PECs in assessing impairment. At least one stakeholder has asked us to consider changing our sediment assessment methods based on the recent Tristate study. Currently, my reservations in doing so include the following: (1) SST10s developed for the Tri-State seem to inherently allow more toxicity than PEC values, (2) SST10s appear to be less accurate at predicting toxicity than PECs, (3) the SST10s may not be protective for early life stages of mussels. I would greatly appreciate your thoughts on these and any other issues related to assessing sediment toxicity and encourage you to share these with me in writing (email or letter). The public comment period on the proposed 2014 Listing Methodology document ends March 15.

“Assessment of Metal Contaminated Sediments for Southeast Missouri Mining District Using Sediment Toxicity Tests...” Besser, J. 2009. US Geological Survey. AR 08-NRDAR-02

Major Findings

1. Big River sediments were more toxic to juvenile mussels (2 mos.) than juvenile amphipods (7 days).
2. Mussel toxicity correlated with bulk sediment metal concentration while amphipod toxicity correlated better with aqueous metals in pore water.
3. Lab studies of mussel toxicity from sediments at several Big R. sites correlated well with observed mussel communities at those sites.
4. Previously established PEC values for Cd and Zn were 85-100% accurate in predicting toxicity to mussels and were 93% accurate in predicting declines in mussel taxa richness. PEC for Pb was less reliable.
5. Mussel toxicity was found at sites nearer to tailings areas which had finer sediments and higher concentrations of Cd and Zn in sediments, and finer average sediment size.

Amphipod toxicity was found at further downstream sites where sediments were somewhat coarser and had lesser amounts of Cd and Zn but greater concentrations of aqueous lead in pore water.

6. Five of six sites on Big River with Cd + Zn PEQ >1.0 were toxic to mussels. Sediments at all sites with a Cd PEQ of 2.4 and Zn PEQ of 1.7 were toxic to mussels. All eight sites with a Cd or Zn PEQ >0.5 had reduced mussel taxa richness compared to historical data.

Comparison of Findings to MacDonald Study in Tri-State Mining District

1. Contrary to Big River study, amphipods were found to be more sensitive to metals than mussels. This study used somewhat older mussels (3-4 months) and there may be a shift in feeding methods to more water filtration as the mussels age, meaning less contact with bottom sediments. Ie, this study may not have evaluated mussels at their most sensitive stage.
2. Sediment Toxicity Threshold (SST) values for lead, zinc and cadmium were established using amphipod toxicity data. SST(10) values for sediment concentration were levels at which a 10% reduction in growth or 10% mortality could be expected. The ability of these SST10s to predict toxicity was 76%. These values were: Pb 150 mg/Kg, Zn 2083 mg/Kg and Cd 11.1 mg/Kg. These concentrations, when translated as PEQs would be: Pb 1.17, Cd 2.23 and Zn 4.54. The Pb PEQ is close to the previously established PEC value for lead and seems to confirm the accuracy of this value. The PEQs for Cd in these two studies are similar but the PEQ for Zn is much higher in the Tri-State study and may not be protective for younger mussels. Had younger mussels been used all of these SST10s may have been lower.
3. MacDonald, using the SST10 values established toxicity indices for mixtures of sediment pollutants including: PEC-Q (all pollutants) = 0.556, PEC-Q (metals) = 1.11, \sum PEC-Q (Cd, Zn, Pb) = 7.92, \sum SST-Q (Cd, Cu, Pb, Zn) = 2.97. These indices were 79-80% accurate at predicting toxicity as measured by survival or biomass of amphipods or mussels.
4. Pore water samples were found to be better predictors of toxicity than bulk sediment analysis